Attorney Docket No. A-70543/RMA/LM
Client Ref.:

PATENT APPLICATION

A COMPUTER WITH SWITCHABLE COMPONENTS

Inventors:

Kenneth Largman,
a citizen of the United States of America, residing at
2460 21st Avenue
San Francisco, California 94116

Anthony B. More,
a citizen of the United States of America, residing at
750 Warfield Avenue #504
Oakland, California 94610

Assignee:

Self Repairing Computers, Inc.,
a California Corporation,
2460 21st Avenue
San Francisco, California 94116

FLEHR HOHBACH TEST ALBRITTON & HERBERT LLP
4 Embarcadero Center
Suite 3400
San Francisco, CA 94111-4187
(415) 781-1989

A COMPUTER WITH SWITCHABLE COMPONENTS

This invention relates to computers, computer repair and computer architecture. More particularly, the invention relates to a computer architecture and software that enables the computer to repair itself.

BENEFIT APPLICATIONS

This application claims the benefit of the following applications:

U.S. Provisional Patent Application No. 60/205,531, entitled, "Scalable, Diagnostic, Repair and Multi-Use System for Computing Hardware & Devices That Utilize Computer Hardware," filed May 19, 2000, naming Kenneth Largman and Anthony More as inventors, with Attorney Docket No. ZAP 2000-1 and commonly assigned to Self-Repairing Computers, Inc. of San Francisco, California; and

U.S. Provisional Patent Application No. 60/220,282, entitled, "Scalable, Diagnostic, Repair and Multi-Use System for Computing Hardware & Devices That Utilize Computer Hardware," filed July 24, 2000, naming Kenneth Largman and Anthony More as inventors, with Attorney Docket No. ZAP 2000-1A and commonly assigned to Self-Repairing Computers, Inc. of San Francisco, California.

U.S. Provisional Patent Applications Nos. 60/205,531 and 60/220,282 are incorporated by reference herein.

BACKGROUND

Personal-computer manufacturers and sellers often offer via-telephone and on-site repair services. Yet purchasers — particularly home, home-office and small-office purchasers — readily complain that their service contract offers less service than they expected. For example, a computer seller may dispatch a technician only after the purchaser calls the help center, performs a number of tests under the direction of the help center, escalates the problem at the telephone help center and performs redundant or additional tests under the direction of a putatively more knowledgeable telephone-help staff. The purchaser may have to escalate the problem still further and perform additional redundant tests before a repair technician is dispatched.

Frequently, the help center directs the customer to cycle the power on the computer, to re-boot the computer, to detach and reattach peripherals in question and to re-install application and operating-system software. Each call to the help center and each level of escalation may require the purchaser to cycle, re-boot, detach and reattach.

Detaching and reattaching peripherals can be extremely inconvenient. USB devices, for example, typically attach at the back of a computer in a location difficult to reach. In any event, the non-digerati purchaser may fear disassembling his computer, worrying that he may damage the computer further.

Help centers even direct a customer to reformat the boot drive of the computer and re-install operating-system and application software. Re-formatting is an onerous task for several reasons. Firstly, the home, home-office and small-office user rarely reformats a drive in the normal operation of his computer and is unfamiliar with the process itself. Secondly, reformatting destroys all the data on the drive, and such a user understandably becomes anxious on finding out that he will lose all of his data. Thirdly, such a user may not retain the application or operating-

system installation media, especially where the seller pre-installs the software. The user may have been unsure which media to keep, or intending to keep a particular media, is in fact unable to locate that media later when needed.

Fourthly, the user typically does not back up his drives as often as an information technologist would recommend. That he will have to rely on his back ups (if any) if he is to have any hope of restoring his application is then not a comforting thought.

Accordingly, the art evinces a need for a computer that reduces or even eliminates the need for a user to call a help line, to keep installation media, to attach and reattach peripherals at the port, etc. Indeed, a computer that reduces or eliminates the technical savvy its user needs to effect repairs is desirable.

These and other goals of the invention will be readily apparent to one of ordinary skill in the art on reading the background above and the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a computer incorporating an embodiment of the invention.

Figure 2 is a schematic of a data-store switch according to an embodiment of the invention.

Figures 3A through **3B** illustrate the switch-and-repair process according to one embodiment of the invention.

Figure 4 illustrates the flow of control in a data-store switch according to one embodiment of the invention.

Figure 5 illustrates a computer incorporating an embodiment of the invention.

Figures 6A, 6B illustrate a computer incorporating an embodiment of the invention. **Figure 6A** illustrates the enabling of a data

store in conjunction with the defeat of access to a communications link. **Figure 6B** illustrates the enabling of a data store in order to support access to the communications link.

Figures 7A, 7B illustrate a computer incorporating an embodiment of the invention. **Figure 7A** illustrates the computer in its Network Disconnected state, while **Figure 7B** illustrates the computer in its Network Connected state.

Figure 8 illustrates a computer incorporating an embodiment of the invention.

Figures 9A, 9B illustrate a computer incorporating embodiments of the invention.

Figure 10 illustrates a computer incorporating an embodiment of the invention.

(The drawings are not to scale.)

SUMMARY

Herein are taught apparatus and methods for a computer to repair itself.

DESCRIPTION OF THE INVENTION

OVERVIEW

An example of the invention in use follows: A user runs an application on a computer incorporating an embodiment of the invention. At some point, the user modifies the application or underlying operating system to the point that the application, the operating system or both become unusable. Indeed, the user may no longer be able to even boot the operating system.

Recognizing that the computer needs to be repaired, the user throws a switch on the computer. The computer fixes the malfunctioning software and so informs the user.

The user can then re-boot the computer. On re-booting, the

user again has access to a correctly functioning operating system, application and data files.

A Self-Repairing Computer

Figure 1 illustrates a computer **1** incorporating an embodiment of the invention. The computer **1** may include a CPU **10**, volatile memory **11**, peripheral controllers **17, 18**, a first non-volatile data store **12** and a bus **15**, all well known in the art.

The computer **1** may also include switches **13, 19**, a second non-volatile data store **14**, a controller **1A**, a power supply **1B**, an output device **1C** and an input device **1D**.

The bus **15** may communicatively couple the volatile memory **11** and the peripheral controllers **17, 18** to each other and to the CPU **10.** The peripheral controllers **17, 18** may communicatively couple with the data stores **12, 14**, respectively.

The switches **13, 19**, the controller **1A**, power supply **1B**, output device **1C** and input device **1D** may form a data-store switch **1Z**. A data-store switch may alter the accessibility of a connected data store according to the setting of the switch.

The controller **1A** may communicatively couple with the switches **13, 19**, the output device **1C** and the input device **1D**. The power supply **1B** may supply the controller **1A** (and other switch components) with power. More particularly, the power supply **1B** may power the controller **1A** independently of the power to the rest of the computer **1**.

The power to the switch **1Z** may come from the same source as the power for the rest of the computer (the wall outlet or laptop battery, for example). The switch **1Z** may then be powered from that supply even when the rest of the computer **1** is not. **Figure 10** illustrates this embodiment of the invention.

The switch **13** may communicate with the data store **12.** The switch may control (toggle, for example) the identification settings of the

data store **12**.

The switch **19** may couple to the data store **14**. The switch **19** may control (toggle, for example) the power to the data store **14**.

The volatile memory **11** may be random-access memory. The data stores **12, 14** may be magnetic disks, for example.

The output device **1C** may be the monitor of the computer **1**, LEDs or an LCD distinct from the monitor, for example.

Figure 2 is a schematic of the data-store switch **1Z** according to an embodiment of the invention. In **Figure 2**, the opto-isolators **U2, U3** implement the switches **13, 19**, respectively. The Basic Stamp II microcontroller **U1** (from Parallax, Inc., Rocklin, California) implements the controller **1A**. The battery **V3** implements the power supply **1B**. The LCD display port **J1** represents the output device **1C**, and the switches **S1, S2** implement the input device **1D**. (Opto-isolator **U4** detects whether the computer **1** has power.)

In a first mode of operation herein termed "normal mode," the computer **1** may run a predetermined operating system and application. Accordingly, the data store **12** may contain a correctly functioning copy of that software. The CPU **10** may access the data store **12**, boot the operating system and then execute that application.

The data store **12** is termed herein the "boot data store." The data store **12** may contain a bootable, executable operating system and executable application.

The data-store switch **1Z** may make the data store **12** accessible to the computer **1** as the boot drive (by means of the switch **13**, for example). The data-store switch **1Z** may also make the data store **14** inaccessible to the computer **1** (by means of the switch **19**, for example). Otherwise, the data-store switch **1Z** may idle, waiting for user input on the device **1D**.

In the normal stage, the computer **1** may perform as a conventional computer. The user may run his application software,

inattentive to the invention incorporated into the computer **1**.

In a third mode of operation herein termed the "repair mode," the CPU **10** may run software on the data store **14** and the controller **1A** may execute a program in parallel. A mode intermediate to the normal and repair modes, herein termed the "switching mode," may effect the transition from normal to repair mode.

In the switching mode, using an input device such as the device **1D** the user may indicate that he wishes to repair software on the data store **12**. (**Figures 3A** and **3B** illustrate the switch-and-repair process according to one embodiment of the invention.) In response to the input, the computer **1** may switch from normal operation to repair, step **310**, and repair the software on the data store **12**, step **320**.

The switching of a data store may be logical or physical. Logical switching is switching enforced purely by software. For example, software may set one or more predetermined bits that it or other software tests to determine whether a data store is accessible at any given time.

A physical switch opens or closes a predetermined electrical circuit of a device to be switched. A physical switch may, for example, alter the open/close state of identification jumpers of a data store. A physical switch may turn on or off the power supply to a device to be switched.

Figure 4 illustrates the flow of control in a data-store switch **1Z** according to one embodiment of the invention. On start up, the data-store switch **1Z** may go into normal mode of operation. In this stage, the switch **1Z** may set the switch **13** to make the data store **12** the boot drive, step **4A3**. The switch also may set the switch **19** to leave the template data store **14** unpowered.

The data-store switch **1Z** may then idle, waiting for the user to initiate the switch to repair mode, step **4A5**. The data-store switch **1Z** may display a message indicating that it is in normal mode, step **4A1**.

When the data-store switch **1Z** receives an indication to switch

to repair mode, the switch **1Z** may ask the user to confirm this indication, step **4B5**. Confirmation is preferable where the repair process is destructive before it is constructive. Confirmation is preferable also because the activation of the input device indicating the switch to repair mode may have been accidental or ill considered.

On confirmation if requested, the data-store switch **1Z** may switch power to the data store **14**, step **4B9**, making the data store **14** accessible to the computer **1**. The data store **14** may be permanently configured to be addressable as the boot drive when it is accessible. Accordingly, the address of the data store **12** may then change.

In normal operation, the data store **12** may be addressable as the boot drive. However, during the switch, the switch **1Z** may change the identity (address jumpers, for example) of the data store **12** to something other than the boot-drive identity.

The computer **1** is now ready to enter the repair stage.

Switched physically to repair mode, the computer **1** may boot from the template boot drive. The booted program or some other program executed during the boot sequence (autoexec.bat, for example, on machines running Windows™ operating system from Microsoft Corp., Redmond, WA) may query the user.

In one embodiment, on rebooting the computer **1** may automatically repair the data drive **12**. It copies software from the template data store **14** to the data store **12** without further direction from the user. Previously set user preferences may, however, direct the course of repair.

Thus, where the template data store **14** contains only application software, the repair process may copy over or re-install that application software from the template data store **12**. Where the template data store contains operating-system and application software, the repair process may copy over or re-install the operating system first and then the application software.

Uninstallation or deletion of an application may precede re-installation or copying over of that software. Re-formatting of the data store **12** may precede re-installation or copying over of the operating system. Resetting of ROM-resident parameters may precede re-installation or copying over of operating-system or application software.

On completion of the repair, the repair software may direct the user to switch back to normal mode and re-boot the computer **1**.

Alternatively, the repair process may be menu-driven. The repair process may present the user a sequence of options to determine what repair process to execute. For example, on re-boot in repair mode, the repair software may offer the choices of running the repair process, reviewing repair-process settings, updating the template software (the application, operating system or repair-process software itself) and quitting the repair process.

The template data store **14** may contain application software, operating-system software and repair-process software. The application software may include the executable software itself (.exe, .dll, .o, etc.) or the files created by the application (.wpd files for Corel WordPerfect word-processing software, for example).

The software on a template data store **14** typically is an operating system and may include one or more applications, along with the underlying software to run the operating system (and any included application) on a computer with a predetermined configuration. The underlying software may include one or more boot records, one or more partition tables or a BIOS.

The template software is created by installing software onto a data store, by copying installed software onto the data store or by copying installation software onto a data store. (Installed software includes data files and other pre-existing software.)

The template data store software may be updated. Where the template software is installation-ready software, that installation software

may be updated to a different, usually later, version. Where the template software is a backup of the software on the data store **12**, a different, usually more recent, backup of the data-store software replaces or supplements that software.

Repair-process settings may include whether to recover data, run a virus check, reformat the data store, revert to a backup, run a human-mediated (i.e., manual) or an automatic repair, run diagnostics (software or hardware, for example). Repair-process settings may also include whether to format and at what level (quick versus low-level, for example), what software to re-install (operating system (OS) only; OS and executable-application software; OS, executable-application software and application data files; data files only, for example), whether to switch automatically (i.e., under program or hardware control), what level of repair to run (quick, better or best, in one embodiment), whence to setup (backup or template, in one embodiment) and whence to recover data files (most recent backup prior to repair, backup at the time of repair, other predetermined backup, query-and-response-specified backup, as examples).

The repair process may entail recovering a usable version of the appropriate data file. In some instances of computer repair, the problem is not so much with the operating-system or executable-application software so much as with the files (usually data files) associated with one or more of the applications. If the application in question is Microsoft Outlook, then the file to be recovered may be the mail-and-folder-data .pst file. Where the application is Microsoft's Internet Explorer, the file to recover may be the favorites file.

Running a virus check may entail first checking that the virus-check-and-repair software is up to date. Because new software attacks appear daily, and because newer malicious code has a higher chance of delivering a payload, this is not a trivial step. The software may then check for malicious code and repair software, as directed by the user or by

default.

The above process presupposes that the data store **14** contains a copy of (a version of) the operating-system, application software or data file on the data store **12**. In this sense, this second data store **14** is termed herein the "template data store." With the computer **1** switched to boot from the template data store **14**, the computer **1** may perform the original copying of template software onto the data store **14**. (Where the data store **14** is a read-only medium, it may arrive at the computer **1** in a pre-written state.)

An example of the operation of the computer **10** follows: Assume that the data store **12** contains a bootable Windows™ operating system (from Microsoft Corp., Redmond, WA). Assume also that the data store **12** also contains NaturallySpeaking® application software (Lernout & Hauspie, Ieper, Belgium and Burlington, MA).

The operating system and the application on the data store **12** may have each been run any number of times, and the user may have customized the operating system, the application or both to his preferences. In contrast, the template data store **14** may contain as-installed copies of the operating-system and the application software.

In the course of using his computer **1**, the user puts the computer **1** into an undesirable state. He may, for example, foul up the optional settings of the operating system or application such that he cannot reset them to a usable state. He may download a virus, trojan horse or other malicious code that changes his operating system, application or both. The particulars of the malicious code are unknown but the manifest effect is that the computer **1** is partially or completely inoperable. He may remove files critical to the correct operation of the software. As one of skill in the art will recognize, the ways in which software may be intentionally or unintentionally altered to the point of unusability are legion.

Recognizing that his computer **1** is in an undesirable state, the

user activates the switch **13**, step **300**. **Figure 3** illustrates the switch-and-repair process according to one embodiment of the invention, and step **310** illustrates the actual switching. In response to the switch activation, step **300**, the computer **1** repairs the software on the data store, step **320**.

The repair process involves copying software from the template data store **14** to the data store **14**. The software on the template data store **14** may be a master copy, a backup copy or an archive copy of software on the data store **12**. (An archive is a copy of software, which copy cannot be overwritten or deleted.)

With template software on the template data store **14**, the computer **1** may re-install or copy over software onto the data store **12**. The computer **1** may overwrite all or part of any software on the data store **12**.

The computer **1** may offer the user options as to how thorough its attempt to repair itself should be. In one embodiment, the computer **1** offers the options of a "Quick Repair," a "Better Repair," a "Best Repair" and a "Test." A Quick Repair may, for example, re-install or copy template software from the data store **14** onto the data store **12** without first re-formatting the data store **12**. The Better Repair may perform a high-level re-format of the data store **12** before that copy or re-installation. A Best Repair may perform a low-level re-format of the data store **12** before copying over or re-installing software.

Figure 4 illustrates the switch-and-repair process in more detail, according to one embodiment of the invention. The switching copies software from the template data store onto the data store, replacing the unusable software on the data store.

A number of situations occur where the computer **1** may effect repair without rebooting. For example, if only data files or application executables need to be repaired, then shutting down the operating system booted from the data store **12** is not usually necessary — especially in newer operating systems such as Windows 2000 (Microsoft) and more

sophisticated operating systems such as Linux .

Further, a large number of operating-system files can be repaired (for example, by replacement) without shutting down the operating system. Repairing the operating system without rebooting is a preferred embodiment.

Still further, for backups (automated or otherwise), continuing to run from the data store already booted may be preferable. Where the computer **1** can become sufficiently quiescent that a backup from the data store **12** to the data store **14** can occur while still booted from the data store **12**, then such a backup is quicker than shutting down and backing up the data store **12** while booted from the data store **14.**

Where the data store **12** remains the boot drive when the data store **14** is simultaneously available, the data store **14** may be addressable as other than the boot drive. The address of the data store **14** may be switched similarly to the address switching of the data store **12.**

A VIRUS- AND HACKER-RESISTANT COMPUTER

Figure 6A illustrates a computer **6** incorporating an embodiment of the invention. The computer **6** may include a CPU **60,** volatile memory **61**, peripheral controllers **67, 68**, first and second non-volatile data stores **62, 64**, data port **69**, communications link **6A** and buses **65, 66**, all well known in the art. The computer **6** may also include a data-store switch **6Z.**

The bus **65** may communicatively couple the volatile memory **61**, the peripheral controllers **67, 68** and the data port **69** to each other and to the CPU **60**. The peripheral controllers **67, 68** may communicatively couple with the data stores **62, 64**, respectively. The data port **69** may mediate access to the communications link **6A.**

The bus **66** may communicatively and electrically couple the peripheral controller **67** to the data store **62** and to the boot-store switch **6Z.** More specifically, the boot-store switch **6Z** may switch the power line **661** of

the bus **66**, thus powering up or down the boot store **62**.

Likewise, the bus **67** may communicatively and electrically couple the peripheral controller **68** to the data store **64** and to the boot-store switch **6Z**. The boot-store switch **6Z** may switch the power line **671** of the bus **66**, powering up or down the boot store **64**.

The port **69** may link the computer **6** to other devices such as a modems, networks, etc. as indicated by the communications link **6A.**

The computer **6** may operate in two states: Connected and Disconnected. In the Disconnected state, the computer **6** does not use the data port **69** to communicate and the data-store switch may enable the data store **62.**

By contrast, in the Connected state, the computer **6** may use the data port **69** to obtain data over the communications link **6A**. In the Connected state, the switch may enable the second data store **64.**

Thus, the computer **6** may enable only one of the multiple data stores **62**, **64** at any given time, which depending on whether it is accessing the communications link **6A.** This isolates data received over the communications link **6A** to one of the data stores, namely, the data store **64.** Where the data received was maliciously created (a virus or a hacking executable), this data is confined to the data store **64.**

The switching of the data stores **62, 64** may be done under manual, hardware or software control. A mechanical throw switched by the user when the user wishes to access (or cease accessing) the communications link exemplifies a manual switch. A boot-store switch **6Z** that responds programmatically to the CPU **60** illustrates a software-controlled switch.

For example, if the user boots an Internet browser and the communications link **6A** is the Internet, then the CPU **60** may programmatically recognize the (intended) launch of a browser and initiate the switch of the data stores **62, 64.** The switch may involve re-booting the computer **6** in order to make the second data store **64** the only

data store available during the use of the communications link **6A**. (A browser on the data store **64** may launch automatically on the boot from the data store **64**.)

In one embodiment, the computer may synchronously switch the port **69** and the second boot store **64**. This may improve the resistance of the computer **6** to hacking or infection.

Figure 6A illustrates the enabling of the data store **62** in conjunction with the defeat of access to the communications link **6A**. The solid line continuing the power line **661** through the boot-store switch **6Z** illustrates the accessibility of the data store **62**. Conversely, the dashed lined through the switch **6Z** illustrates the inaccessibility of the data store **64.**

Figure 6B illustrates the enabling of the data store **64** in order to support access to the communications link **6A**. The solid power line through the boot-store switch **6Z** illustrates the accessibility of the data store **64.** Conversely, the dashed lined through the switch **6Z** illustrates the inaccessibility of the data store **62.**

The data store **64** may contain application software to process the data received over the link **6A**. In such a setting the need to migrate the data on the data store **64** to the data store **62** may be minimal or non-existent.

Where, however, the application to process the data received over the link **6A** and stored on the store **64** resides on the data store **62**, then a process of migration is necessary. A predetermined time after receiving data over the link **6A**, the computer may simultaneously enable the data stores **62, 64** and copy the data received to the data store **62** for processing there. The delay allows, for example, anti-virus software providers to produce and distribute security software addressing threats that have come to light since the time of receipt of the data.

The migration process may be manual or automatic.

A LOCKABLE NETWORK COMPUTER

Figure 7A illustrates a computer **7** incorporating an embodiment of the invention. The computer **7** may include a CPU **70,** volatile memory **71**, a peripheral controller **77**, a non-volatile data store **72,** a data port **79**, a communications link **7A** and buses **75, 77**, all well known in the art. The computer **7** may also include a switch **7Z.**

The bus **75** may communicatively couple the volatile memory **71**, the peripheral controller **77** and the data port **79** to each other and to the CPU **70.** The peripheral controller **77** may communicatively couple with the data store **72.** The data port **79** may mediate access to the communications link **7A.**

The bus **77** may communicatively or electrically couple the data port **79** to the communications device **7B.**

The port **79** may link the computer **7** to other communicators through a communication device **7B** and over a communications link **7A.** Examples of the communications device **7B** and link **7A** include an acoustic modem **7B** and a POTS telephone line **7A**; a tap **7B** and an ethernet **7A**; and a wireless modem **7B** and radiation-permeable space **7A.**

The switch **7Z** may switch a power line **771** of the bus **77**, thus powering up or down the communications device **7B.** The switch **7Z** may switch (tri-state, for example) a data line **771** of the bus **77**, thus interrupting or enabling the ability of the communications device **7B** to transfer data to the data port **79.**

The computer **7** may operate in two states: Network Connected and Network Disconnected. **Figure 7A** illustrates the computer **7** in its Network Disconnected state, while **Figure 7B** illustrates the computer **7** in its Network Connected state. (The solid line continuing the power line **761** through the switch **7Z** illustrates the continuity of the power or data line **771**, and dashed lined through the switch **7Z** illustrates the discontinuity of that line **771**.

In the Network Disconnected state, the switch **7Z** may disconnect the communications device **7B** from communicating on the data port **79**. Accordingly, none of the software running on the computer **7** may access the communications link **7A**.

By contrast, in the Network Connected state, the switch **7Z** may enable the communications device **7B** to communicate on the data port **79**. Accordingly, software on the computer **7** may access the communications link **7A**.

An exemplary use for the computer **7** is where a parent uses the computer **7** to access, say, his employer's computer network via a virtual private network (VPN) over the Internet **7A**. The parent also wants his child to be able to use the computer **7** for school or recreation — but without access to the Internet **7A**. The parent thus switches the computer **7** into the Network Enabled state when he (the parent) wants to use it, and switches the computer **7** into the Network Disconnected state when the child is to use the computer **7**.

The switching of the data stores **72, 74** may be done under manual, hardware or software control. A mechanical switch thrown by the user when the user wishes to access (or cease accessing) the communications link **7A** exemplifies a manual switch. A mechanical switch that may be locked with a key, for example, is preferable.

A switch **7Z** that responds programmatically to the CPU **70** illustrates a software-controlled switch **7Z**. (The CPU **70** may respond to any kind of input, including keystrokes, voice commands, biometric data and data received over a network.) A hardware switch **7Z** may be considered as an analog computer.

A computer **7** running an operating system that supports hot swapping offers an advantage. The addition and removal of the communications device **7B** from the computer **7** may confuse OSs that do not permit hot swapping of peripherals.

A MULTI-DATA STORE SERVER

Figure 8 illustrates a computer **8** incorporating an embodiment of the invention. The computer **8** may include a CPU **80**, volatile memory **81**, a peripheral controller **87**, multiple non-volatile data stores **82a, 82b, . . . 82α**, a data port **89**, a communications link **8A** and a bus **85**, all well known in the art. The computer **8** may also include a data-store switch **8Z** and a bus **86** consisting of the buses **861** or **862**.

The bus **85** may communicatively couple the volatile memory **81**, the peripheral controller **87** and the data port **89** to each other and to the CPU **80**. The data port **89** may mediate access to the communications link **8A**.

The peripheral controller **87** may communicatively couple with the data-store switch **8Z**. The data-store switch **8Z** in turn may communicatively or electrically couple to the data stores **82**. The bus **861** may communicatively couple the data path of the switch **8Z** to those of the data stores **82**, and the bus **862** may electrically couple a power supply in or through the switch **8Z** to the data stores **82**.

The data port **89** may mediate access to the communications link **6A**. The port **89** links the computer **8** to other communicators over the communications link **7A**.

The computer **8** may operate in any of N states, where N is the number of data stores **82**. In a first state, the data-store switch **8Z** enables the first data store **82a** to communicate with the peripheral controller **87**. In the second state, the switch **8Z** enables the second data store **82b** to communicate with the peripheral controller **87**, and in the Nth state, the switch **8Z** enables the Nth data store **82α** to communicate with the peripheral controller **87**.

The corruption or other failure of the data store **82** currently communicating with the controller **87** prompts the switching from one state to another, and thus from the failed data store to another, working data

store **82**. (The failed data store **82** may then be repaired in place, or it may be removed and repaired, removed and replaced, or removed permanently.)

Where, for example, the computer **9** is a web server and the communications link **8A** is the Internet, the multiple data stores **82** may provide resistance against infection and hacking by malicious users of the Internet **8A**. If the hackers succeed in corrupting the data store currently attached to the peripheral controller, then a switching may occur from that corrupted data store **82** to another correct data store **82**. This switching may occur very quickly (preferably as quickly as possible) in order to minimize the loss of access to the data on the data stores **82**.

The switching may be manual, hardware or programmatic. For example, a diagnosis program may execute periodically to determine the health of the currently accessible data store **82**.

A COMPUTER WITH PERIPHERALS THAT CAN BE CYCLED

Figure 9A illustrates a computer **9** incorporating an embodiment of the invention. The computer **9** may include a CPU **90**, volatile memory **91**, a controllers **97, 98**, a non-volatile data store **92**, a port **99**, a peripheral **9B** and buses **95, 97**, all well known in the art. The computer **9** may also include a switch **9Z**.

The bus **95** may communicatively couple the volatile memory **91**, the controllers **97, 98** to each other and to the CPU **90**. The controller **97** may communicate with the data store **92**. The controller **98** may communicate with the peripheral **9B**.

The bus **97** may communicatively or electrically couple the port **99** (and thus the controller **98**) to the peripheral **9B**.

The peripheral **9B** may be any computer peripheral. Examples include printers, USB devices, scanners, fax machines, data stores and keyboards.

The switch **9Z** may switch a power line **971** of the bus **97**, thus

powering up or down the peripheral **9B**. The switch **9Z** may switch one or more data lines 972 of the bus **97**, thus disabling or enabling the peripheral **9B** to transfer data to the port **99**.

A user of the computer **9** may be using the peripheral **9B**, transmitting or receiving data on the from the device **9B** as expected. The switch **9Z** is supplying power to the peripheral **9B**.

At some point, the computer **9** becomes unable to communicate with the peripheral **9B**. This may be caused by an error in the software or hardware of the computer **9**, including software or logic of the peripheral **9B**.

The user attempts to revive communications with the peripheral **9B**. The user may. for example, cycle the power to the peripheral **9B**. Thus, the user changes the state of the switch **9Z** such that the switch **9Z** goes from powering to the peripheral **9B**, to not powering that peripheral **9B**, to again powering that peripheral **9B**. This switching may be done manually, in hardware, or programmatically.

The cycling of the peripheral **9B** may resolve the communication problem that the user was experiencing. For example, where the problem was with the software or logic of the peripheral **9B**, then the power cycling may clear the software or logic state of the peripheral **9B**. Where the problem was with the software or logic of the computer **1**, cycling the power may clear the software or logic state f the controller **97** or applications running in the memory **91**.

Figure 9B illustrates an alternate embodiment of the computer **9**. The switch **9Z** switches both power and data lines.

A MULTI-USER COMPUTER

Figure 5 illustrates a computer **5** incorporating an embodiment of the invention. The computer **5** may include a CPU **50**, volatile memory **51**, a peripheral controller **57**, multiple non-volatile data stores **52a, 52b, . . . 52α** and a bus **55**, all well known in the art. The computer **5** may also

include a data-store switch **5Z** and a bus **56** consisting of the buses **561** or **562**.

The bus **55** may communicatively couple the volatile memory **51**, the peripheral controller **57** and the data port **59** to each other and to the CPU **50**.

The peripheral controller **57** may communicative with the data-store switch **5Z**. The data-store switch **5Z** in turn may communicatively or electrically couple with the data stores **52**. The bus **561** may communicatively couple the data path of the switch **5Z** to those of the data stores **52**, and the bus **562** may electrically couple a power supply in or through the switch**5Z** to the data stores **52**.

The computer **5** may operate in any of N states, where N is the number of data stores **52**. In a first state, the data-store switch **5Z** enables the first data store **52a** to communicate with the peripheral controller **57**. In the second state, the switch **5Z** enables the second data store **52b** to communicate with the peripheral controller **57**, and in the Nth state, the switch **5Z** enables the Nth data store **52**α to communicate with the peripheral controller **57.** Only one data store **52** may access the peripheral controller **57** at any given time.

In one embodiment, the computer **5** has only one controller with multiple devices. In another embodiment, the computer **5'** has multiple controllers, each with respective multiple peripherals. The switching then switches among the multiple peripherals of the first controller, the multiple peripherals of the second controller, etc. (The multiple controllers need not have the same number of multiple peripherals.)

Each data store **52** may contain self-contained software for a respective user or group of users. Each data store **52** may contain a bootable operating system, and optionally such application or data files as the user(s) corresponding to the data store **52** may require or desire.

Each user or group of users may use only a predetermined one

(or more) of the data stores **52**. Thus, before using the computer **5**, a user sets the switch **57** to the predetermined position enabling the data store **52** corresponding to that user to communicate via the controller **57**.

In this way, a first user's data is separated from a second user's data on the same computer. The computer **5** more effectively separates users' data by enforcing security at a physical level rather than at the logical (software-enforced) level typical of multi-user operating systems.

In this scenario, re-booting between switches is desirable. Re-booting clears out the memory **51** in the switch from one user to another. Also desirable is a multi-key, multi-position lock. Any one key may turn the lock to any one predetermined position, enabling one corresponding data store **52**.

The invention now being fully described, one of ordinary skill in the art will readily recognize many changes and modifications that can be made thereto without departing from the spirit of the appended claims. For example, in addition to switching software, data stores or other peripherals as described above, a computer may also switch properly functioning hardware for malfunctioning hardware. Indeed, in a computer with multiple mother boards, a switch may switch the functioning components of a computer from one board to another.

Also, while the description above usually uses data stores as the devices to switch, one of skill in the art will readily now realize that other computer components may be switched, including logic boards, ROM and controllers.

Under certain circumstances, danger or damage may follow from switching when power is supplied. Accordingly, a switch may be deactivated when such danger or damage may result. Logic such as the controller **1A** may prevent dangerous or damaging switching by tracking power states, device identities, etc. and permitting switching, for example, when no electrical current is flowing to the devices to be switched.

Preferably, the switch is located in an easy-to-reach location. This contrasts with the typical location of USB, keyboard and other ports, for example.

Attached is a 209-page Appendix which is a part of this specification. The Appendix includes the following documents:

- "Description of Self-Repairing System" (Text, 5 pages; Drawings, 4 Pages; Code, 5 Pages)
- "Backup and/or Repair System - Multi-User System" (Text, 43 Pages)
- Diagrams (Text, 18 Pages)
- Table of Which Diagrams Go With Which Embodiments (Text, 1 Page)
- Figures, S Series (Drawings, 20 Pages)
- Figures, F Series (Drawings, 38 Pages)
- Figures, W Series (Drawings, 32 Pages)
- Figures, M Series (Drawings, 5 Pages)
- Figures, E Series (Drawings, 17 Pages)
- Figures, L Series (Drawings, 21 Pages)